

USER MANUAL | UNREGISTERED USER

# SHOCK VML Portal

Date: 29<sup>th</sup> April 2014

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## INTRODUCTION

### PURPOSE OF THIS DOCUMENT

This document is intended for users who want to use the web portal **Virtual Mission Laboratory** (hereinafter only **VML**). It includes instructions, use cases and describes all features of the portal from the viewpoint of an unregistered user.

### SW REQUIREMENTS

For proper and full functionality of VML portal, you need to use a web browser with JavaScript and HTML5.

#### Recommended web browsers:

- Mozilla Firefox (version 19 or higher)
- Chrome (version 25 or higher)
- Internet Explorer (version 10 or higher)

## WEB INTERFACE

## MAIN PAGE

Main page contains 4 basic elements:

1. **Main menu** for basic navigation on web page
2. **List of projects** includes all projects in the VML portal and their short description
3. **Contact | RSS feed** for the possibility to contact us or subscribe for news about new projects and simulations on the portal
4. **List of new simulations** includes 5 newly added simulations

1

HOME    ABOUT US    PROJECTS    COMPARATIVE STUDIES    LOG IN

2

SHOCK. Virtual Mission Laboratory Portal

HOME    ABOUT US    PROJECTS    COMPARATIVE STUDIES    LOG IN

NEWEST SIMULATIONS

Project	Simulation	Info	Show in wizard
Project IMF-North-Planetward	IMF-North-Planetward	Hybrid simulation of Mercury's interaction with the ... (more)	Show in wizard
Kelvin-Helmholtz	Hybrid-KH1	Hybrid simulation of Kelvin-Helmholtz instability ... (more)	Show in wizard

PROJECTS

Project	Info
Kelvin-Helmholtz	Hybrid simulations of Kelvin-Helmholtz instability.
Project IMF-North-Planetward	Global hybrid simulations of Mercury's interaction with the Solar wind.

Author of data: Pavel M. Travnikov | The portal is created under SHOCK Project of the FP7 (EC)

EU CERN ESA Queen Mary University of London CNRS Sprinx Systems University of St Andrews

PROJECTS

» Kelvin-Helmholtz  
Hybrid simulations of Kelvin-Helmholtz instability.

» Project IMF-North-Planetward  
Global hybrid simulations of Mercury's interaction with the Solar wind.

3

Contact    RSS feed

4

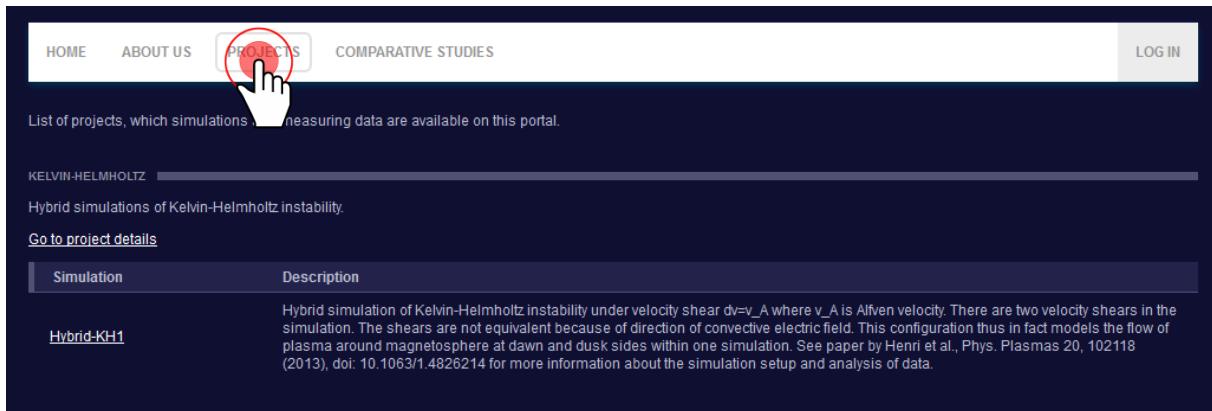
NEWEST SIMULATIONS

List of latest simulations uploaded to this portal. With newest on top.

Project	Simulation	Info	Show in wizard
Project IMF-North-Planetward	IMF-North-Planetward	Hybrid simulation of Mercury's interaction with the ... (more)	Show in wizard
Kelvin-Helmholtz	Hybrid-KH1	Hybrid simulation of Kelvin-Helmholtz instability ... (more)	Show in wizard

## PROJECTS AND SIMULATIONS

An overview of projects and simulations that VML portal contains can be found in the **Project** tab in main menu. It includes all projects and their simulation including detailed descriptions.



HOME ABOUT US PROJECTS COMPARATIVE STUDIES LOG IN

List of projects, which simulations and measuring data are available on this portal.

KELVIN-HELMHOLTZ

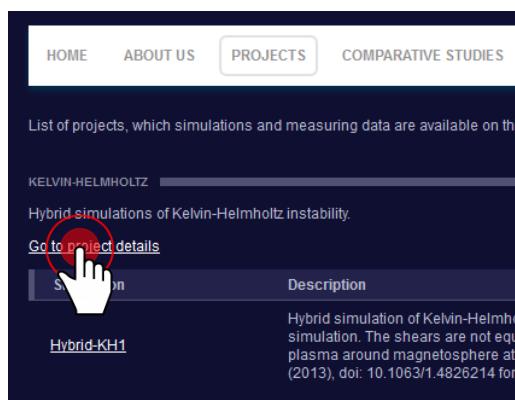
Hybrid simulations of Kelvin-Helmholtz instability.

[Go to project details](#)

Simulation	Description
<a href="#">Hybrid-KH1</a>	Hybrid simulation of Kelvin-Helmholtz instability under velocity shear $dv=v_A$ where $v_A$ is Alfvén velocity. There are two velocity shears in the simulation. The shears are not equivalent because of direction of convective electric field. This configuration thus in fact models the flow of plasma around magnetosphere at dawn and dusk sides within one simulation. See paper by Henri et al., Phys. Plasmas 20, 102118 (2013), doi: 10.1063/1.4826214 for more information about the simulation setup and analysis of data.

If you want to go **project details**, use one of the following ways:

### 1 From Projects tab



HOME ABOUT US PROJECTS COMPARATIVE STUDIES

List of projects, which simulations and measuring data are available on this portal.

KELVIN-HELMHOLTZ

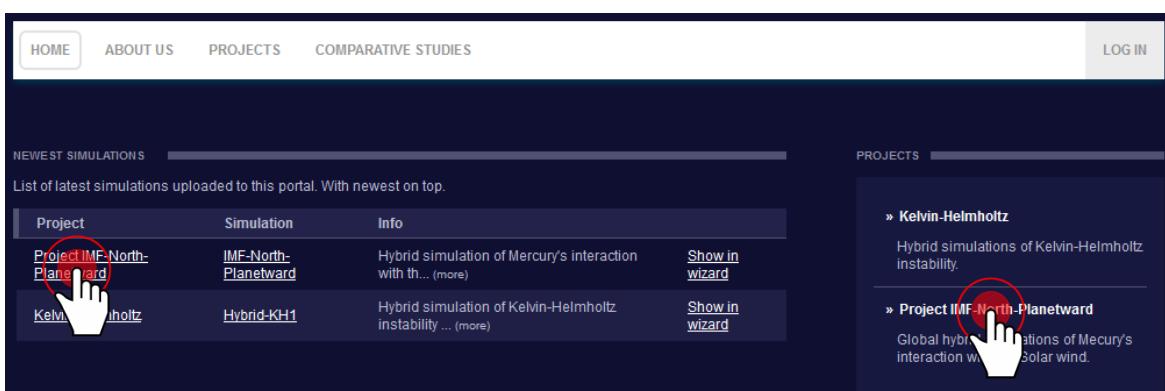
Hybrid simulations of Kelvin-Helmholtz instability.

[Go to project details](#)

Simulation	Description
<a href="#">Hybrid-KH1</a>	Hybrid simulation of Kelvin-Helmholtz instability under velocity shear $dv=v_A$ where $v_A$ is Alfvén velocity. There are two velocity shears in the simulation. The shears are not equivalent because of direction of convective electric field. This configuration thus in fact models the flow of plasma around magnetosphere at dawn and dusk sides within one simulation. See paper by Henri et al., Phys. Plasmas 20, 102118 (2013), doi: 10.1063/1.4826214 for more information about the simulation setup and analysis of data.

Or

### 2 From Home tab



HOME ABOUT US PROJECTS COMPARATIVE STUDIES LOG IN

NEWEST SIMULATIONS

List of latest simulations uploaded to this portal. With newest on top.

Project	Simulation	Info	Show in wizard
<a href="#">Project IMF-North-Planetward</a>	<a href="#">IMF-North-Planetward</a>	Hybrid simulation of Mercury's interaction with the ... (more)	<a href="#">Show in wizard</a>
<a href="#">Kelvin-Helmholtz</a>	<a href="#">Hybrid-KH1</a>	Hybrid simulation of Kelvin-Helmholtz instability ... (more)	<a href="#">Show in wizard</a>

PROJECTS

- » [Kelvin-Helmholtz](#)  
Hybrid simulations of Kelvin-Helmholtz instability.
- » [Project IMF-North-Planetward](#)  
Global hybrid simulations of Mercury's interaction with the Solar wind.

Page with **project details** shows all information about project, figures and list of their simulations including basic information and available products.

The screenshot shows the SHOCK Virtual Mission Laboratory Portal. At the top, the logo 'SHOCK. SOLAR AND HELIOSPHERIC COLLISIONLESS KINETICS' is on the left, and the text 'Virtual Mission Laboratory Portal' is on the right. Below the logo, there is a navigation bar with 'HOME', 'ABOUT US', 'PROJECTS' (which is highlighted in a box), 'COMPARATIVE STUDIES', and 'LOG IN' on the right. The main content area is titled 'Project IMF-North-Planetward'. It includes a 'DETAILED DESCRIPTION' section with text about three-dimensional hybrid simulations of Mercury's magnetosphere. To the right, there is a 'PROJECTS' sidebar with '» Kelvin-Helmholtz' and '» Project IMF-North-Planetward'. Below the description, there is a 'PROJECT IMAGES' section with three figures: a schematic of Mercury's magnetosphere, a 2D simulation plot of the magnetic field, and a 1D time-series plot of a magnetic field component. At the bottom, there is a 'LIST OF SIMULATIONS' section for 'IMF-North-Planetward' with a description and a list of available products: B, B<sub>x</sub>, B<sub>y</sub>, B<sub>z</sub>, Density. The bottom of the page features logos for the European Space Agency (ESA), Queen Mary University of London, CNRS, Springer Systems, University of St Andrews, and the University of Warwick.

For more detailed information about chosen simulation click on the drop down element.

The screenshot shows the SHOCK Virtual Mission Laboratory Portal. It is similar to the previous one but includes a large red circle with a white crosshair cursor over the 'IMF-North-Planetward' simulation entry in the 'LIST OF SIMULATIONS' list, indicating it is being interacted with.

Then you can find information about all available products, coordinate system, initial conditions and parameters of the simulation. There are also predefined wizard settings (**simulation presets**). Presets usually are interesting settings defined by administrator of the project.

**LIST OF SIMULATIONS**

**IMF-North-Planetward**

*Hybrid simulation of Mercury's interaction with the solar wind under northward-planetward interplanetary magnetic field.*

Available products:  $B$ ,  $B_x$ ,  $B_y$ ,  $B_z$ ,  $Density$

**COORDINATES**

Coordinate system is centered in Mercury's center and unit of length is Mercury's radius. Axis X is parallel to solar wind flow direction; axis Z is parallel to Mercury's dipole axis; axis Y completes right-handed system.

**INITIAL CONDITIONS**

Plasma conditions in (background) unperturbed solar wind are as follows: Magnetic field is northward-planetward,  $B=(0.94, 0.0, 0.34)$  in simulation units. Plasma flow is super-Alfvenic,  $v=(4v_A, 0, 0)$ . Proton kinetic to magnetic pressure ratio is  $\beta_p=0.5$ .

**PARAMETERS**

Grid size:  $N_x=594$ ,  $N_y=N_z=286$ ; Time step:  $dt=0.01$  in units of inverse proton gyrofrequency. Cell size:  $dx=0.4$ ,  $dy=dz=1$  in units of proton inertial length; Mercury's radius:  $R=15.9$  in units of proton inertial length.

**SIMULATION PRESETS**

- [Density - example 2](#)
- [Magnetic field - example 1](#)

**PRODUCTS IN SIMULATION**

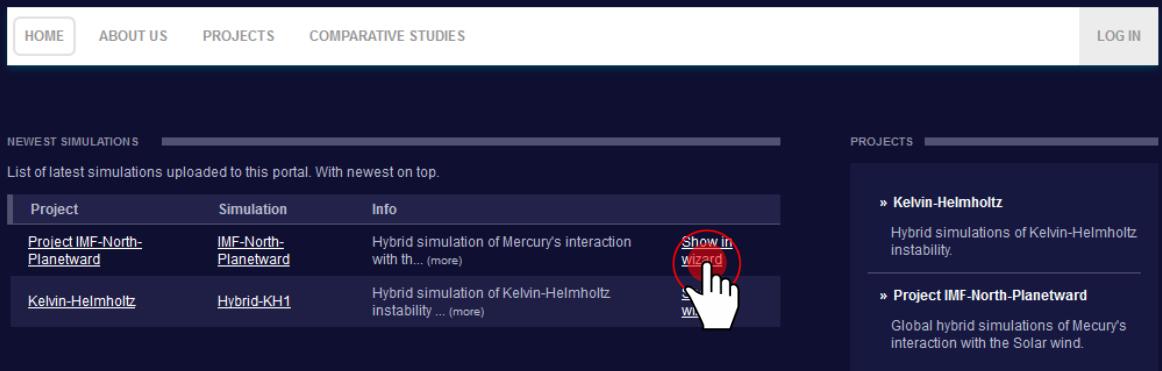
- $B$  - Magnitude of magnetic field
- $B_x$  - Magnetic field component in the direction of the solar wind flow
- $B_y$  - Magnetic field component in the direction of Mercury's orbital motion
- $B_z$  - Magnetic field component in the direction of Mercury's dipole axis
- $Density$  - Proton charge density

## VISUALISATION WIZARD

There are 4 ways how to get into visualization wizard of the simulation:

1

From **Home** tab



HOME ABOUT US PROJECTS COMPARATIVE STUDIES LOG IN

NEWEST SIMULATIONS

List of latest simulations uploaded to this portal. With newest on top.

Project	Simulation	Info
<a href="#">Project IMF-North-Planetward</a>	<a href="#">IMF-North-Planetward</a>	Hybrid simulation of Mercury's interaction with th... (more)
<a href="#">Kelvin-Helmholtz</a>	<a href="#">Hybrid-KH1</a>	Hybrid simulation of Kelvin-Helmholtz instability ... (more)

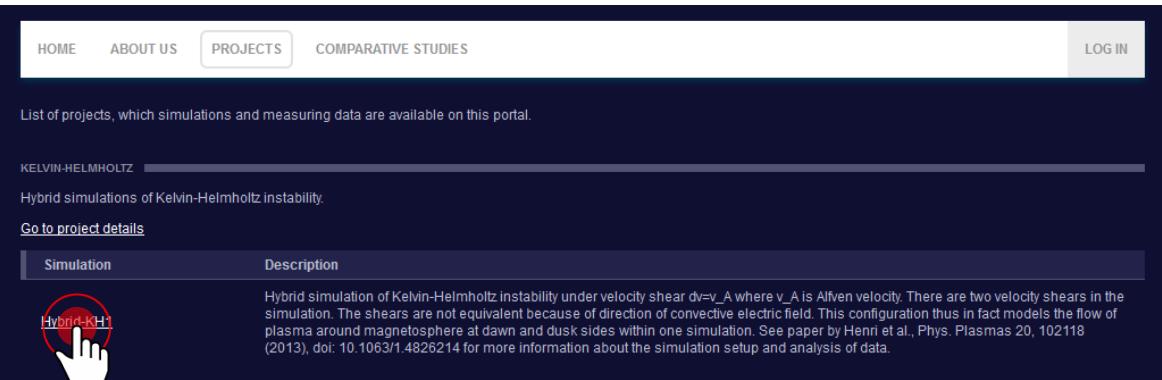
PROJECTS

- » [Kelvin-Helmholtz](#)  
Hybrid simulations of Kelvin-Helmholtz instability.
- » [Project IMF-North-Planetward](#)  
Global hybrid simulations of Mercury's interaction with the Solar wind.

Or

2

From **Projects** tab



HOME ABOUT US PROJECTS COMPARATIVE STUDIES LOG IN

KELVIN-HELMHOLTZ

Hybrid simulations of Kelvin-Helmholtz instability.

[Go to project details](#)

Simulation	Description
<a href="#">Hybrid-KH1</a>	Hybrid simulation of Kelvin-Helmholtz instability under velocity shear $dv=v_A$ where $v_A$ is Alfvén velocity. There are two velocity shears in the simulation. The shears are not equivalent because of direction of convective electric field. This configuration thus in fact models the flow of plasma around magnetosphere at dawn and dusk sides within one simulation. See paper by Henri et al., Phys. Plasmas 20, 102118 (2013), doi: 10.1063/1.4826214 for more information about the simulation setup and analysis of data.

Or

3

From **Simulation list** in the project details page



LIST OF SIMULATIONS

**IMF-North-Planetward**

Hybrid simulation of Mercury's interaction with the solar wind under northward-planetward interplanetary magnetic field.

Available products: B, Bx, By, Bz, Density

Or

4

From unrolled **Simulation details** in the project details page

You can choose one of the simulation preset.

**IMF-North-Planetary**  
Hybrid simulation of Mercury's interaction with the solar wind under northward-planetward interplanetary magnetic field.  
Available products:  $B$ ,  $B_x$ ,  $B_y$ ,  $B_z$ , Density

**COORDINATES**  
Coordinate system is centered in Mercury's center and unit of length is Mercury's radius. Axis X is parallel to solar wind flow direction; axis Z is parallel to Mercury's dipole axis; axis Y completes right-handed system.

**INITIAL CONDITIONS**  
Plasma conditions in (background) unperturbed solar wind are as follows: Magnetic field is northward-planetward,  $B=(0.94, 0, 0, 0.34)$  in simulation units. Plasma flow is super-Alvenic,  $v=(4v_A, 0, 0)$ . Proton kinetic to magnetic pressure ratio is  $\beta_{\text{alpha}}=0.5$ .

**PARAMETERS**  
Grid size:  $N_x=594$ ,  $N_y=N_z=286$ ; Time step:  $dt=0.01$  in units of inversed proton gyrofrequency. Cell size:  $dx=0.4$ ,  $dy=dz=1$  in units of proton inertial length; Mercury's radius:  $R=15.9$  in units of proton inertial length.

**SIMULATION PRESSETS**

- [Density - example 2](#)
- [Magnetic field - example 1](#)

**PRODUCTS IN SIMULATION**

- $B$  - Magnitude of magnetic field
- $B_x$  - Magnetic field component in the direction of the solar wind flow
- $B_y$  - Magnetic field component in the direction of Mercury's orbital motion
- $B_z$  - Magnetic field component in the direction of Mercury's dipole axis
- Density - Proton charge density

## BASIC OVERVIEW



The screenshot shows the SHOCK Virtual Mission Laboratory Portal interface. The main title is "Virtual Mission Laboratory Portal" with the subtitle "SHOCK. SOLAR AND HELIOSPHERIC COLLISIONLESS KINISTICS". The top navigation bar includes links for HOME, ABOUT US, PROJECTS (which is the active tab), COMPARATIVE STUDIES, and LOG IN.

The central content area is titled "Project IMF-North-Planetward | IMF-North-Planetward". It describes a "Hybrid simulation of Mercury's interaction with the solar wind under northward-planetward interplanetary magnetic field." Available products listed are B, B<sub>x</sub>, B<sub>y</sub>, B<sub>z</sub>, Density.

Below this, there are two preset boxes: "Preset #1" (Product: B<sub>x</sub>) and "Preset #2" (Product: Density). Each preset box contains a list of parameters and a "Remove" button.

On the right, a note says "(click to add a new preset)".

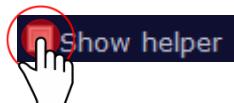
Below the preset boxes is a "Time Selection" section with a slider and radio buttons for "Single Time : 65" and "Time Range". The "Step size" is set to 1. A note says "Samples: 65 (total 1)".

On the left, there are several dashed boxes with labels pointing to specific features:

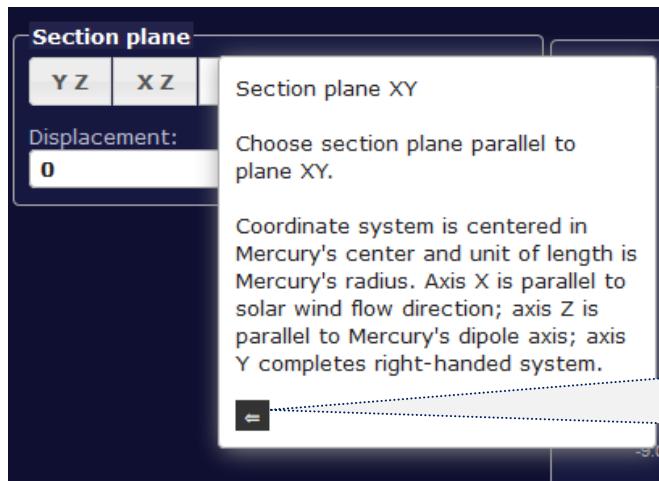
- Information about the simulation** (points to the project title and description area)
- Allow/Disable helper** (points to the "Show helper" checkbox in the preset boxes)
- Product selection** (points to the "Product" dropdown menus in the preset boxes)
- Time selection** (points to the time selection controls)
- Plane selection** (points to the "Section plane" dropdown and "Displacement" input field)
- Three-dimensional situational picture** (points to the 3D wireframe cube visualization)
- Queue for processing button** (points to the "Queue for processing" button at the bottom of the visualization area)
- Two-dimensional situational picture** (points to the 2D grayscale visualization)

## WORKING WITH HELPER

For new users we highly recommend to **allow helper**.



After clicking on the element help guide pops up with additional information and what to do in this step (similarly as shown below).



**Note:** If there is a button in the helper window you can change settings by click on them or move to the next step.

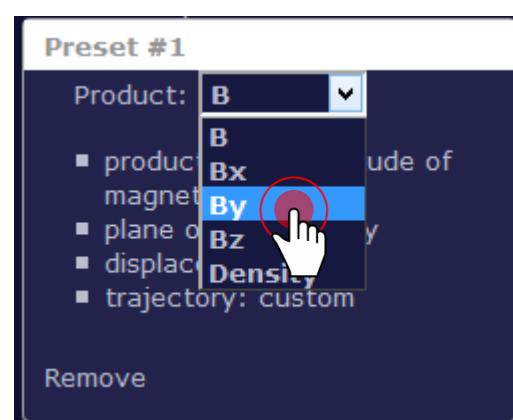
STEP BY STEP VISUALIZATION

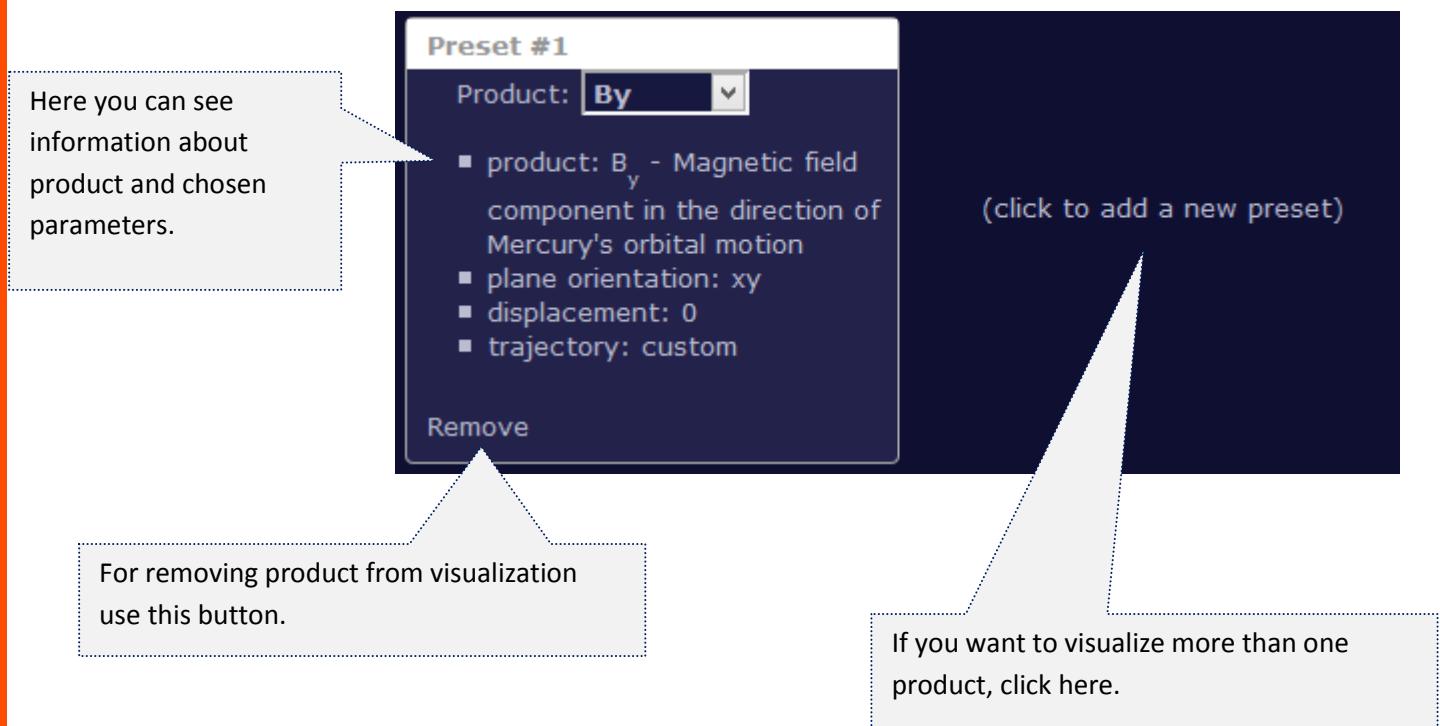
## VISUALIZATION STEP BY STEP

1

### Product selection

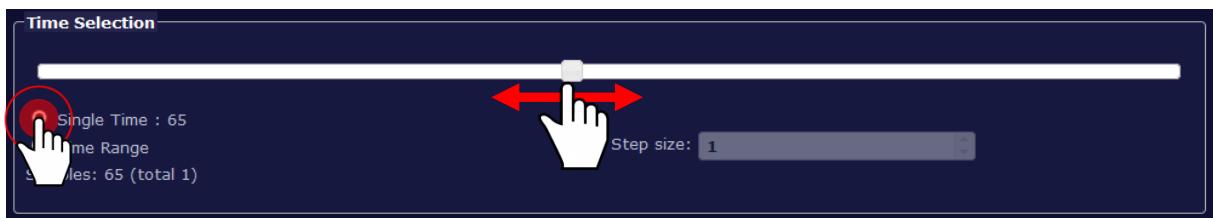
Choose required **product** from the list. The term **product** means a physical quantity that you want to visualize.





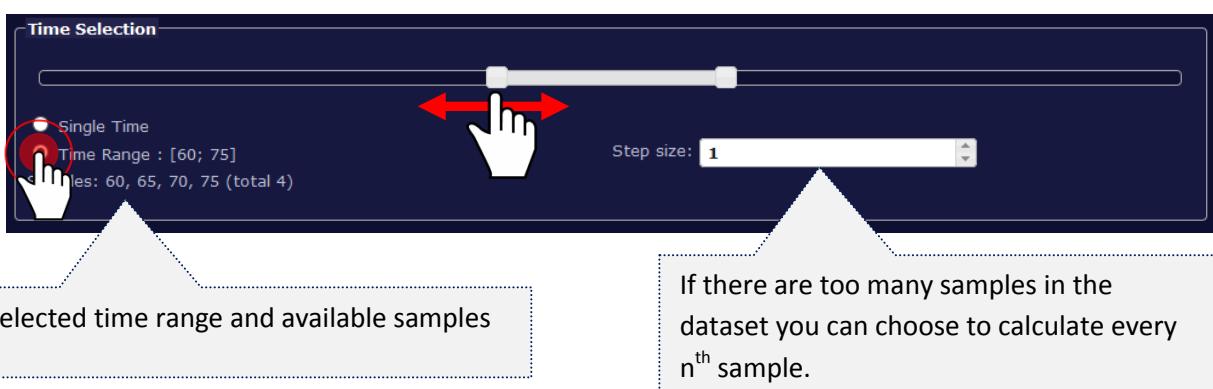
## 2 Time selection

Here you have 2 options. First one is to select only one time. Then all the products will be shown in this **single time** (static figure). Select time by moving with the time cursor.



Or

The second option is to set **time range**. Then all the products will be shown in this time range (animation). Select the time by moving start time and end time cursor.



Selected time range and available samples

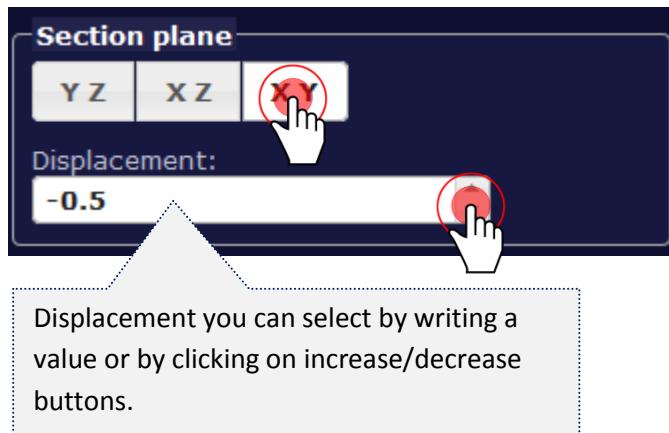
If there are too many samples in the dataset you can choose to calculate every  $n^{\text{th}}$  sample.

3

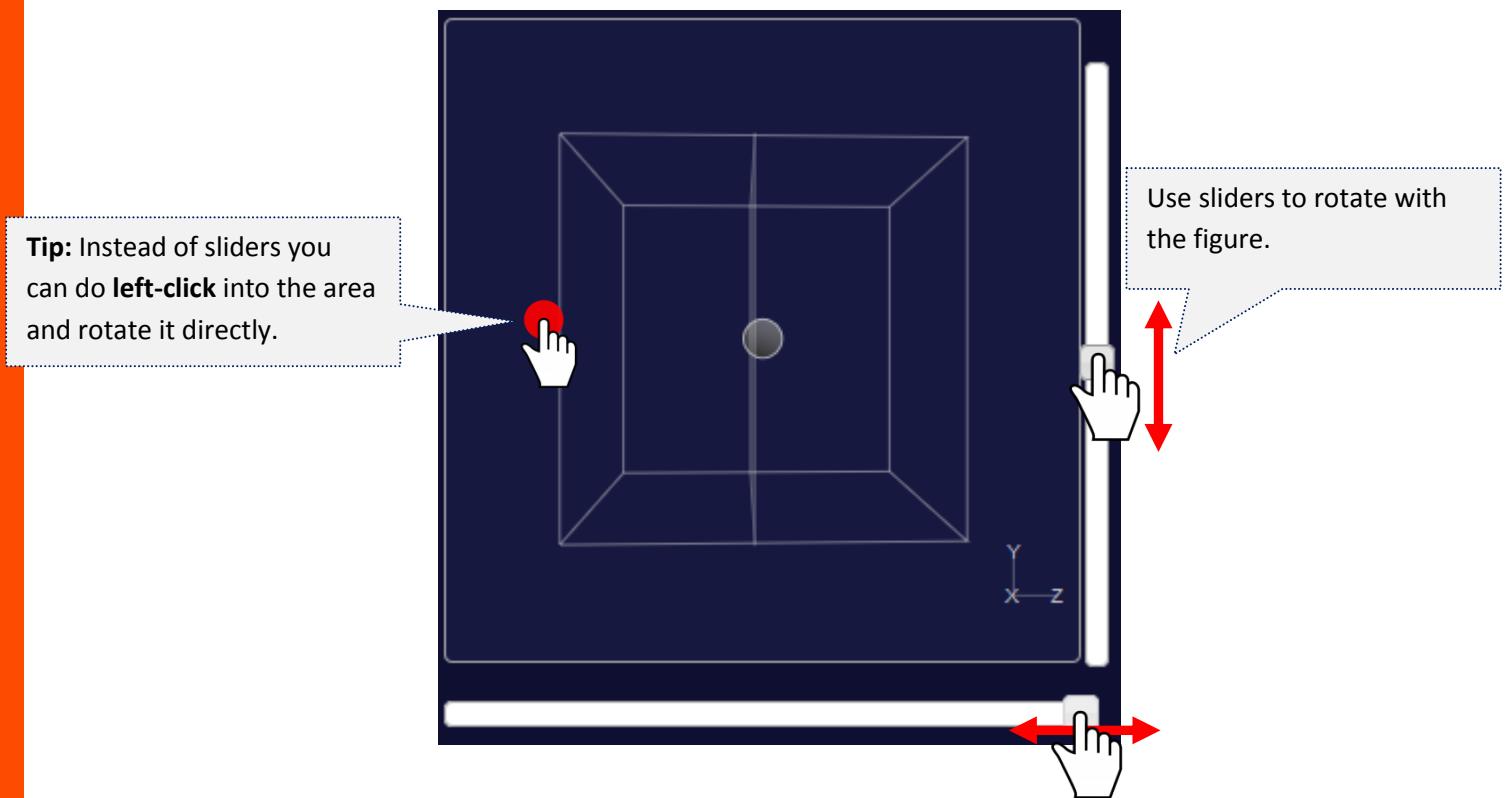
## Plane selection

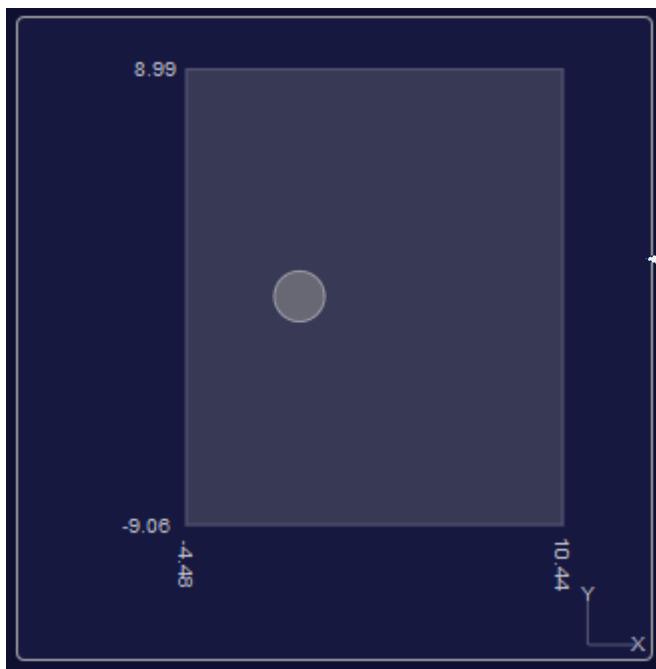
**Note:** This step is present only in case of three-dimensional simulation. Naturally, there is no plane selection in two-dimensional simulation.

In this step you select parameters of the plane you want to visualize. There are 3 options of an **orientation of the plane**. First choose one of the following options – XY | XZ | YZ. Secondly select **displacement** of the plane in space.



For better imagination what you set up you can watch **situational figures**.





Two-dimensional situational picture is for preview with planet position and selected trajectory (this possibility is available when the user logs in).

4

#### Final step – “Queue for processing”

If you are satisfied with your settings click the “**Queue for processing**” button. Then your job will be moved into the queue for processing. When your job is finished you'll see the visualization output.



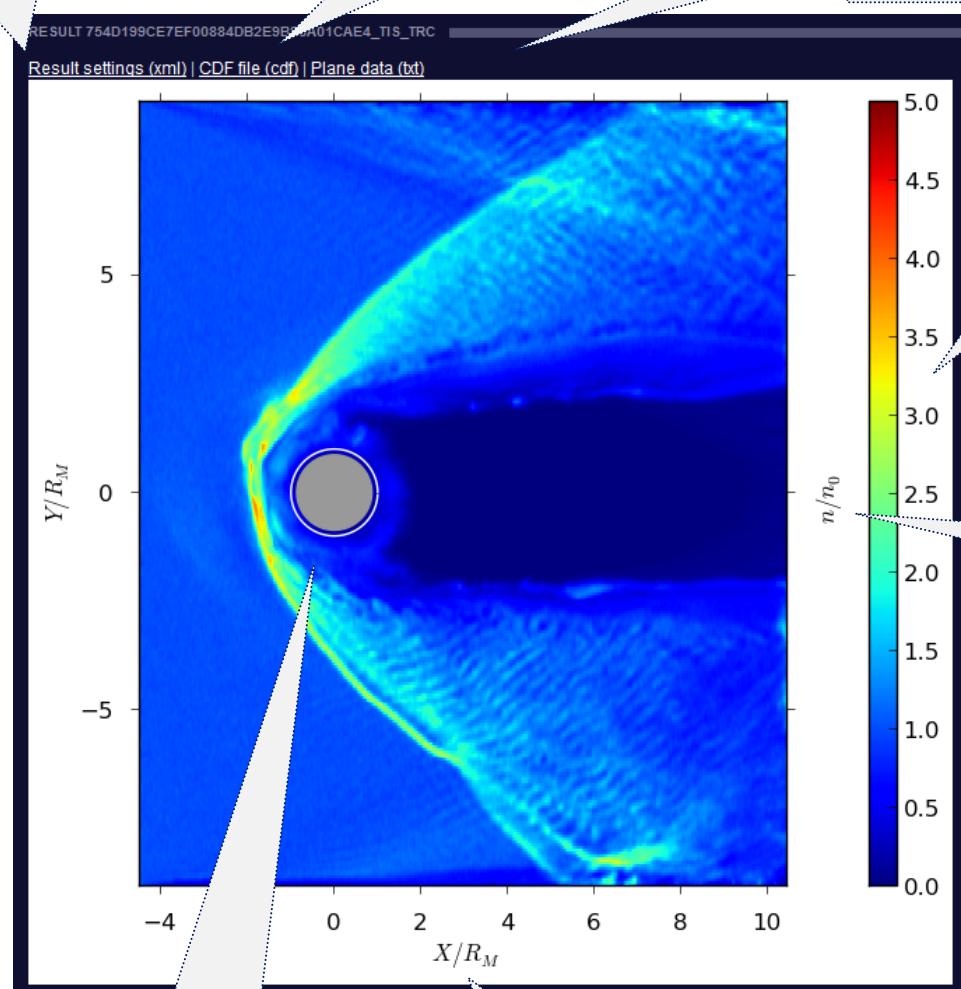
## VISUALIZATION OUTPUTS

### SINGLE TIME

**Result settings (xml)** is the output where you can find all selected settings in xml form. **It is for information purposes.**

**CDF file (cdf)** is the output containing all the numerical values of selected plane in CDF file form.

**Plane data (txt)** is the output containing all the numerical values of selected plane in textual form.



**Illustration of the planet**

The **gray color** indicates cross section the planet.

The **white color** indicates contour the planet.

**Axis label with units**

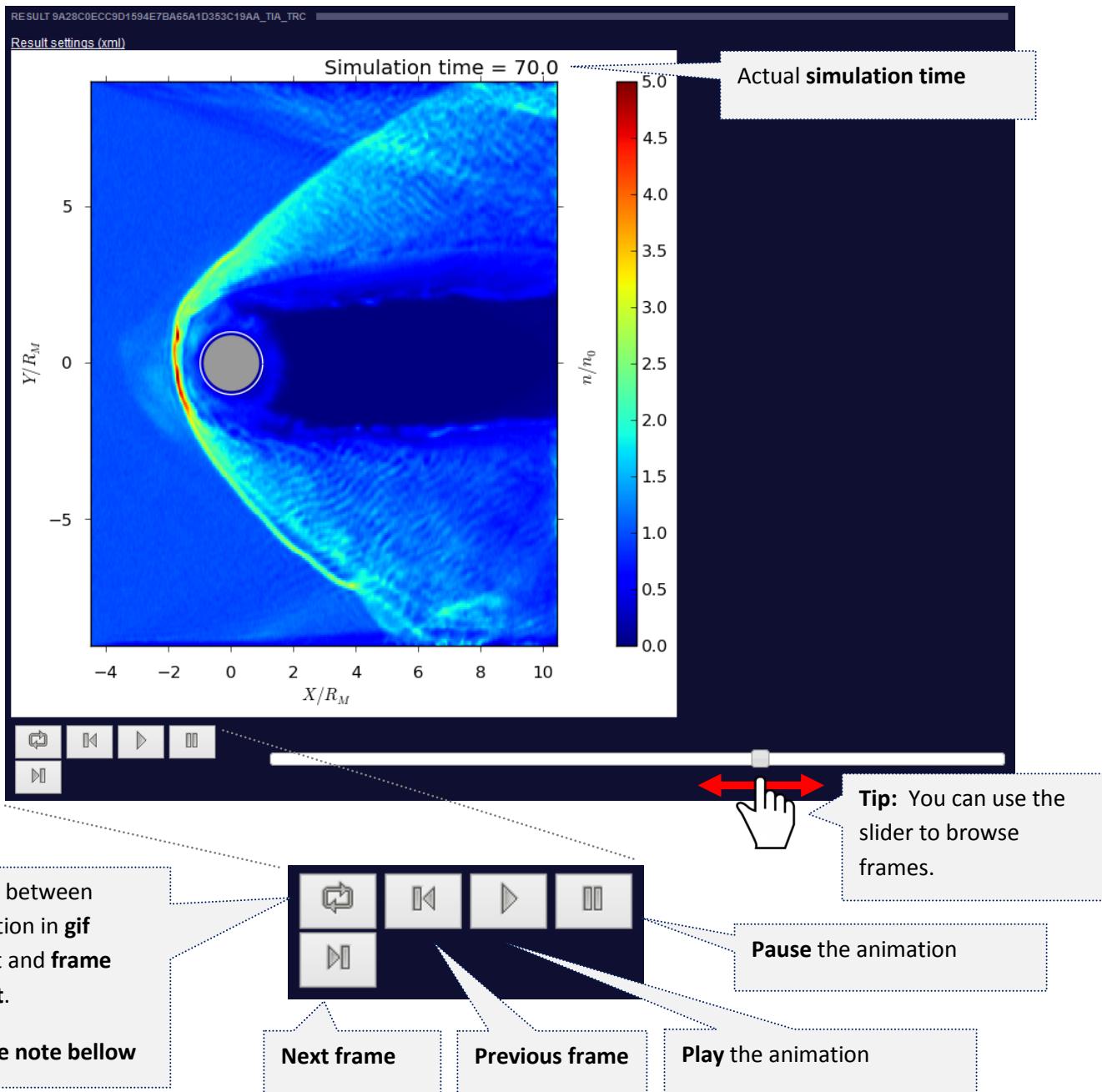
**Color bar for the correct interpretation of the values in the figure**

**Product name with units**

## TIME RANGE

The time range output is similar to the single time output. Description of output elements you can find in the previous chapter.

**Note:** Outputs in the CDF and textual file format are not listed because of their potential size. If you want to get the output in this format, please select option - single time (step 2).



**Note:** There are two animation formats (gif and frame format). Gif format is here for the possibility saving animation. In that case use **right-click** and choose option “**save image as**”. Please note that switching between formats may take a few seconds.